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(54) CUTTING TOOL WITH REMOVABLE CUTTING INSERT

(71) We, DIAGRIT GRINDING COMPANY LIMITED, a British Company of Station Road, Staplehurst, Tonbridge, Kent, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a cutting tool with a removable cutting insert and which in some respects resembles the cutting tool described in our British Patent No. 1,232,024. The invention is particularly, but not exclusively, concerned with a parting-off tool, that is a tool for completely severing a machined length of workpiece from a bar stock in a machine. However, the invention is also applicable to tools for machining grooves in a workpiece.

It has long been known to provide parting-off tools with a cutting tip of hard material, for example tungsten carbide, brazed on to a tool holder of less hard material such as mild steel. In general parting-off tools are provided with a shank whose sides are either very narrow to correspond with the width of the cutting edge along the entire length of the shank or, alternatively, the shank may be tapered to a region of narrow cross-section adjacent the tool to provide increased rigidity to the tool. For manually-operated machines, that is machines with a manual tool feed, it is acceptable to use a parting-off tool with a tapered shank for a certain range of sizes of workpiece cross-section since a machine operator can take corrective action to prevent the depth of cut being limited by engagement of the full-width shank portion of the tool holder with the work. However, with an automatic machine it is desirable to provide a tool which will cut an entire cross-section of the workpiece straight through and for this reason a shank which is narrow along its entire length is preferable for a parting-off tool.

With the aforesaid cutting tool a disposable insert is received in a specially-formed pocket in the tool shank and clamping means are provided whereby the tool insert is firmly and securely located in the pocket and cutting forces upon the insert tend to urge the insert more firmly into the pocket. Once any edge becomes worn the insert can be turned round in the pocket to present a fresh cutting edge to the workpiece. In the pocket for the tool one side of the pocket is defined by a flat face of the shank which results in a tool of comparatively large width immediately beyond the cutting edge of the insert. In order to provide a parting-off tool of narrow width for some distance adjacent the insert the tool pocket must be specially formed to locate the insert.

According to the present invention a cutting tool comprises a tool holder provided with a tool pocket for retaining a multiple-sided cutting tool insert formed with one or more cutting edges, said pocket having two or more sides which each include opposite facing edge portions for engaging corresponding opposite facing edge portions of complementary shape on the insert sides, and clamping means with a clamping surface of complementary shape to one or more insert sides whereby the insert is clamped into the pocket and movement generally transverse to said edge portions is inhibited.

Desirably, locating means are provided for locating the clamping means with respect to said pocket whereby to inhibit movement in said transverse direction.

For example, said locating means comprises a tongue and groove arrangement between said clamping means and tool holder.

In practice, said tool pocket may comprise an open sided V-shaped notch defined by two intersecting edges of curved transverse shape, the sides of the pocket being open and the tool insert being prevented from moving transversely by the engagement of its side edges of curved shape with the complementary curved transverse shape of the side edges of the pocket.

The tool pocket is conveniently formed in a plate which is attached to the shank

of the tool holder. In this way the pocket can be machined separately prior to attachment to the shank.

Desirably, the shank of the tool holder is relieved, that is of reduced cross-sectional area, at one end and provided with a recess at that end for receiving the plate containing the tool pocket. This relieving allows the tool to be used as a parting-off tool providing the necessary side clearance alongside the pocket for the cutting tool insert.

Desirably, a coolant liquid supply passage is arranged to direct coolant liquid to a cutting edge of a cutting tool insert mounted in the tool pocket.

In a preferred construction, said passage extends through a clamp member arranged to clamp the tool into said pocket and having a clamping surface adjacent said cutting edge.

The invention also provides a cutting tool insert for location in a cutting tool according to any of the ten immediately preceding paragraphs.

In one embodiment of the invention the cutting tool insert is generally triangular in form, each of its three side edges being afforded a curved transverse shape, the tips of the triangle being machined to form a series of three equi-angularly spaced cutting edges and the side faces of the insert being hollow ground in each of three side edges to afford side clearance to each of the three cutting edges. The tool pocket for such a cutting tool insert has sides of outwardly convex transverse shape.

Parting-off tools proposed hitherto have employed a cutting tip of tungsten carbide which is brazed on to the tool holder itself. These suffer from a disadvantage that only a limited amount of regrinding can be performed before the whole tool must be rejected, whereas with the present invention a new insert may be put in position once the three positions of the one insert have been fully utilised. Regrinding of the inserts may be performed without disturbing the positioning of the tool holder, it simply being necessary to replace the insert with a fresh one while grinding is carried out.

There now follows a description of a particular embodiment of the invention, by way of example only with reference to the accompanying diagrammatic drawings in which:—

Figure 1 shows a perspective exploded view of a cutting tool;

Figure 2 shows a modification of the tool holder shown in Figure 1;

Figure 3 shows another modification of the tool holder shown in Figure 1;

Figure 4 shows a side elevation of a triangular cutting tool insert for use with the tool holder of Figures 1 to 3;

Figure 5 shows a plan view of the cutting tool insert shown in Figure 4;

Figure 6 shows a side elevation of an assembled tool, similar to that shown in Figure 1, with a coolant supply arrangement;

Figure 7 shows an alternative coolant supply arrangement to that shown in Figure 6;

Figure 8 shows another alternative coolant supply arrangement to that shown in Figure 7, and

Figure 9 shows a further alternative coolant supply arrangement to that shown in Figures 6, 7 and 8.

Referring to the drawings, a parting-off tool with a removable cutting tool insert comprises a tool holder with a shank 11 of generally rectangular cross-section and which is machined at one end to form a relieved portion 12. The latter provides the necessary side clearance for the tool to enable a narrow width of cut to be effected for parting-off or grooving operations. At the relieved end 12 of the tool holder shank 11 there is provided a recess for receiving a separate plate 13 in which is machined a tool pocket 14. The tool pocket 14 takes the form of a generally V-shaped notch in the upper edge of the plate 13, the sides 22 of the pocket 14 including opposite facing edge portions to engage corresponding opposite facing edge portions on the sides 21 of a cutting tool insert 20, shown in Figs. 4 and 5. In this particular construction the pocket sides 22 are curved when viewed in transverse cross-section and the insert sides 21 are of complementary curved shape. The triangular cutting tool insert 20, is located in the tool pocket 14 and is secured firmly in position by means of an overhead bridge-type clamp 16 which is clamped in position by means of a clamping bolt 18 received in a corresponding threaded bore 19 in the shank 11 of the tool holder. The clamp 16 includes a narrow nose 17 the underside of which is also of complementary cross-sectional shape to the side edges 21 of the cutting tool insert 20 and this nose 17 engages the latter's uppermost side edge when in position in the tool pocket 14. The clamp 16 is located in position and prevented from swivelling about the clamping bolt 18 and thereby disturbing the lateral seating of the cutting tool insert 20 in the tool pocket 14 by means of a tongue and groove arrangement. The latter comprises, in the arrangement of Figure 1, a transverse rectangular-section tongue 24 on the underside of the clamp 16 for reception in a rectangular section channel 23 on the upper surface of the shank 11. Two alternative arrangements are shown in Figures 2 and 3. In the arrangement of Figure 2, a longitudinal V-section channel 25 is formed in the upper surface of the shank 11 for receiving a comple-

mentary V-section tongue 26 on the underside of the clamping member 16. In Figure 3 a longitudinal rectangular section notch 28 for receiving a corresponding rectangular section longitudinal tongue 27 on the clamping member 16 is provided for location of the clamping member 16.

The cutting tool insert 20 is machined adjacent its corners to form a series of three equi-angularly-spaced cutting faces 32 with cutting edges 31. As is more readily appreciated from Figure 5, the side faces 30 of the cutting tool insert 20 are also hollow ground to form side-clearance concavities to promote the cutting action of the tool. This hollow grinding is performed along each of these directions perpendicular to the three side edges 21 of the cutting tool insert 20. The cutting faces 32 are machined at an angle slightly departing from a right angle to the general planes containing the side edges of the cutting tool insert 14 in order to provide a "lead-in" or front clearance to the cutting edges 31.

The curved shape of the three side edges 21 of the cutting tool insert 20 and the complementary curved shape of the side edges 22 of the tool pocket 14 and the underside of the nose 17 of the clamp 16, together ensure very firm location of the cutting tool insert 20 in any of its three possible orientations in the tool pocket 14, particularly in the transverse direction that is generally parallel to the cutting edges 31.

The curved shape of the side edges 21 and of the cutting edges 31 affects the chip formation. The chips formed during the cutting action of the tool are in fact curved in cross-section and therefore occupy less width in the machining groove than would be the case for a straight cutting edge. In this way chip removal is facilitated. The pocket 14 and cutting tool insert 20 are hard to promote a long life of the tool holder.

In order to provide an effective coolant supply it is preferable for the coolant to be fed direct to the cutting edge 31. This can be achieved with any one of the alternative coolant supply arrangements illustrated in Figures 6 to 9 for the tool previously described with reference to Figures 1 to 5. Thus, referring to Figure 6, the clamp 16 has a coolant supply passage 37 drilled in it which connects at the rear of the clamp 16 to a coolant supply passage 36 in the tool holder shank 11. A union 35 is provided at the end of the passage 36 for effecting connection to a coolant source. The forward end of the passage 37 emerges at a point on the upper edge 21 of the cutting insert 20 adjacent the cutting edge 31. This arrangement enables the coolant to penetrate beneath the chip formed at the cutting edge 21 during machining operations, leading to improved chip formation, reduced cutting friction and facilitating the final cut-off or parting-off operation.

A similar advantage is gained with arrangements of Figures 7 to 9. Referring to Figure 7, coolant is supplied direct to a pipe 38 lying in a recess in the upper surface of the clamp 16. Figure 8 shows a modification in which a pipe 39 connects with a passage 40 in the clamp 16. Figure 9 shows another modification in which a pipe 41 passes through the clamp 16, then runs in a recess on the underside of the clamp 16 adjacent the upper side edge 21 of the cutting insert 20. Without arrangements such as the various ones described with reference to Figures 6 to 9 there is a possibility of an operational condition arising in which, with a tool penetration of, say, $\frac{1}{4}$ inch the chip being formed by the machining operation tends to seal off the groove being machined thereby obstructing the penetration of coolant and possibly preventing the coolant from reaching the cutting edge 31.

It is envisaged that the tool holder may be adapted for use with automatic machines where there is no manual control over any depth of cut limitations introduced by virtue of the engagement of the relieved portion of the tool shank with the work. Such a tool will have narrow width along a large portion of its length resulting in an appropriate modification in the clamping arrangement, although a similar configuration of pocket would be suitable. The tool described is suitable for cutting dimensions of bar from $\frac{1}{4}$ inch diameter to 2 inch diameter. Tools may, of course, be designed for cutting other cross-sectional sizes of workpiece. In addition, the tools may be used for machining grooves. Furthermore, several tools according to the present invention may be arranged side-by-side in a common tool fixture to provide a multiple grooving tool, for use in say, machining piston ring grooves. A common clamping and coolant supply arrangement could be employed in such tools.

WHAT WE CLAIM IS:—

1. A cutting tool comprising a tool holder provided with a tool pocket for retaining a multiple-sided cutting tool insert formed with one or more cutting edges, said pocket having two or more sides which each include opposite facing edge portions for engaging corresponding opposite facing edge portions of complementary shape on the insert sides, and clamping means with a clamping surface of complementary shape to one or more insert sides whereby the insert is clamped into the pocket and movement generally transverse to said edge portions is inhibited.

2. A cutting tool, as claimed in Claim 1,

wherein locating means are provided for locating the clamping means with respect to said pocket whereby to inhibit movement in said transverse direction.

3. A cutting tool, as claimed in Claim 2, wherein said locating means comprises a tongue and groove arrangement between said clamping means and tool holder.

4. A cutting tool, as claimed in any of the preceding claims, wherein said pocket comprises an open sided V-shaped notch defined by two intersecting edges of curved transverse shape, the sides of the pocket being open and the insert being prevented from moving transversely by the engagement of its side edges of curved shape with the complementary curved transverse shape of the side edges of the pocket.

5. A cutting tool, as claimed in any of the preceding claims, wherein the pocket is formed in a plate which is attached to the shank of the tool holder.

6. A cutting tool, as claimed in Claim 5, wherein the shank of the tool holder is relieved, that is of reduced cross-sectional area, at one end and provided with a recess at that end for receiving the plate containing the pocket.

7. A cutting tool, as claimed in any of the preceding claims, including a coolant liquid supply passage arranged to direct coolant liquid to a cutting edge of an insert mounted in the pocket.

8. A cutting tool, as claimed in Claim 7, wherein said passage extends through a clamp member arranged to clamp the insert into said pocket and having a clamping surface adjacent said cutting edge.

9. A cutting tool substantially as hereinbefore described with reference to, and as shown in, any of Figures 1, 2, 3, 6, 7, 8 and 9 of the accompanying drawings.

10. A cutting tool insert for location in a cutting tool according to any of the preceding claims.

11. A cutting tool insert, as claimed in Claim 10, which is generally triangular in form, each of its three side edges being afforded a curved transverse shape, the tips of the triangle being machined to form a series of three equi-angularly spaced cutting edges and the side faces of the insert being hollow ground in each of three side edges to afford side clearance to each of the three cutting edges.

12. A cutting tool insert substantially as hereinbefore described with reference to, and as shown in, Figures 4 and 5 of the accompanying drawings.

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1369096 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

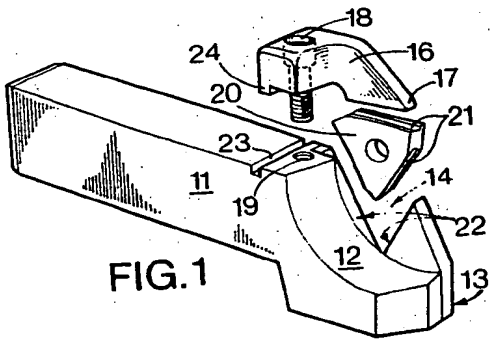

FIG.1

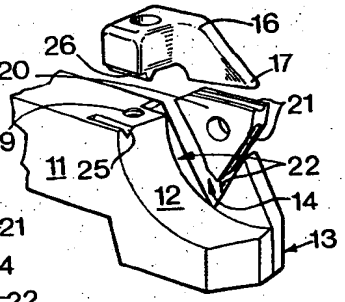

FIG. 2

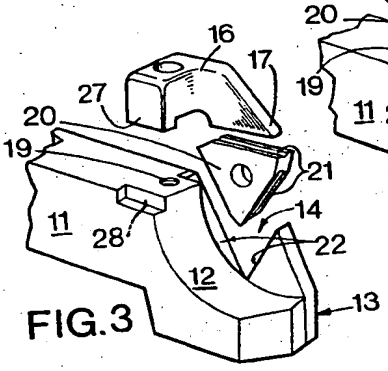

FIG.3

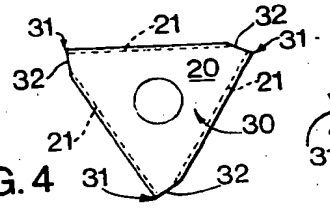

FIG. 4

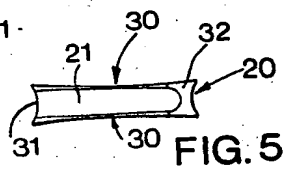

FIG. 5

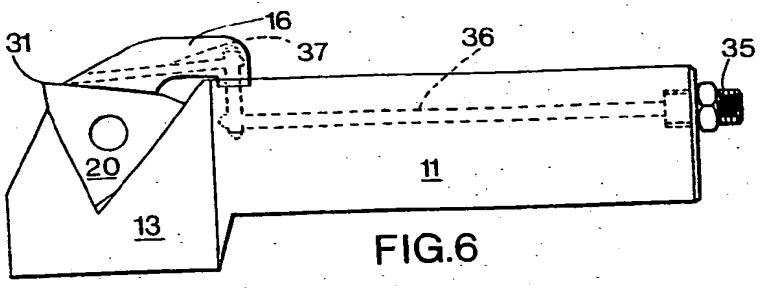

FIG.6

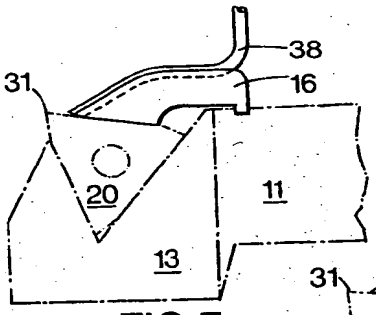

FIG.7

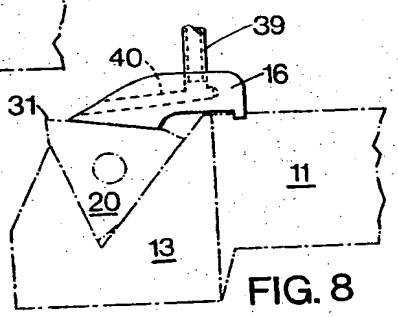

FIG. 8

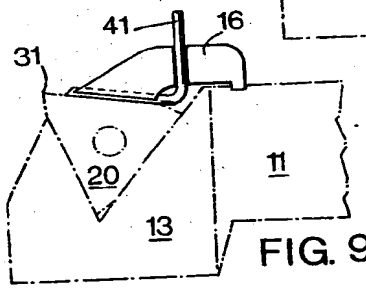

FIG. 9